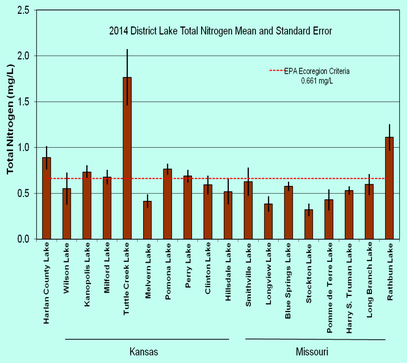
Clinton Lake Water Quality Summary
2005 - 2014

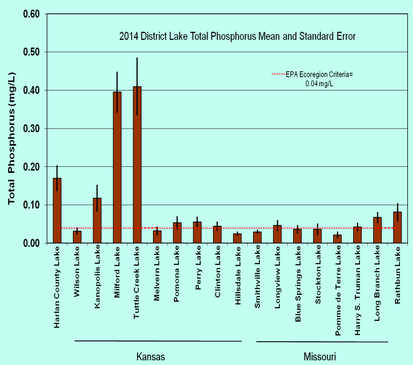
Clinton Lake:

- Located at RM 22.2 of the Wakarusa River
- **Watershed** = 367 sq miles (234,880 Acres)
- **Capacity (2009 sediment survey):**
  - Flood Control: 292,496 Acre Feet (AF) / 13,688 surface acres (SA)
  - Multipurpose: 118,699 AF / 7,205 SA / 82 miles of shoreline
  - Multipurpose pool sediment reserve: 8,299 AF
- **Operating project purposes**: flood control, water quality, recreation, fish and wildlife, and water supply.
- **Avg. annual inflow** (2005-2014)= 147,283 AF; **2014 inflow** = 54,905 AF
- **Water Quality** at Clinton Lake in 2014 was beneficial to operating purposes listed above and measured parameters did not exceed KS State WQ Standards for designated uses. Water quality improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

Nutrient Enrichment

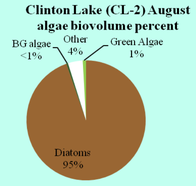
Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen that affect fish survival, and lead to taste and odor issues in drinking water. Clinton Lake is on the 2014 Ks 303(d) list of impaired waters for eutrophication. EPA and KDHE are working with water quality partners and landowners to focus watershed conservation efforts on priority or target areas in the watershed to reduce nutrient and sediment runoff to meet water quality goals for the upper Wakarusa River and Clinton Lake. In 2014, Clinton Lake average total nitrogen (TN) and total phosphorus (TP) was less than average for all Kansas City District Lakes which calculated to 0.68 mg/L and 0.094 mg/L, respectively. TN average of 0.59 mg/L was less than EPA Ecoregion recommended levels while TP measured at the Clinton Lake dam (CL-2) was slightly more than EPA Ecoregion recommended criteria. Standard error bars in the graphs below illustrate the variation in sample results from each site in 2014.

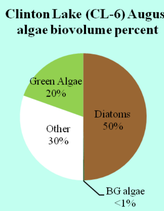


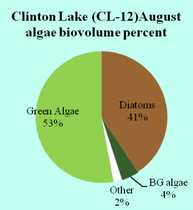


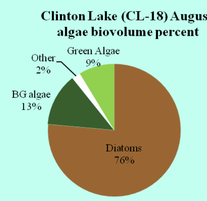
Algae

Algae and green plants are the base of the food chain in a lake and function to convert nutrients and CO_2 via photosynthesis into biomass for all aquatic life. In Clinton Lake, the algae community is repressed from lack of sunlight penetration due to turbid water and suspended sediment. August and Sept. phytoplankton sampling indicated that 70-99% of the algae species were diatoms in the upper and lower lake with 1% or less blue green algae. Algal cell counts were very low with maximum Blue Green Algae count of 16,042 cells/mL in one August sample (CL-6). USACE toxin samples collected in July-Sept did not detect any algal toxins.



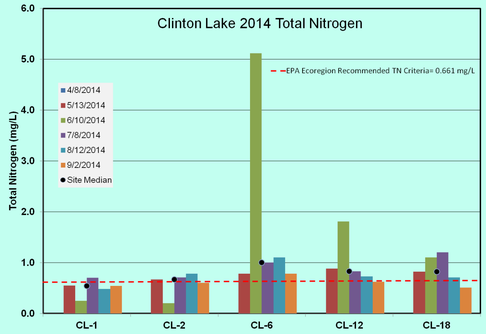






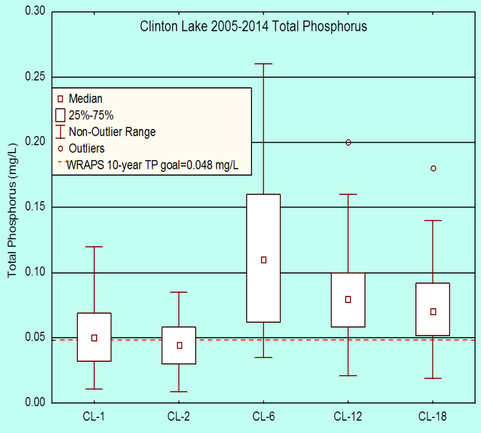
Total Nitrogen

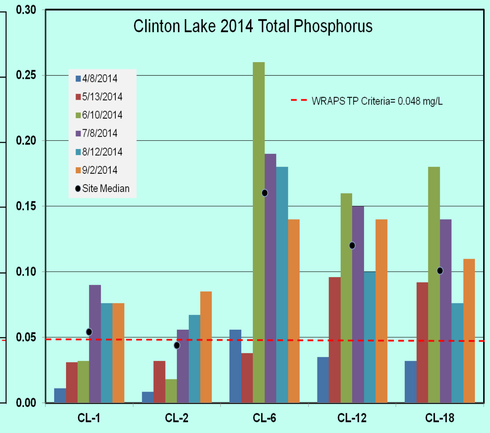
Median total nitrogen concentrations at Clinton Lake sites are slightly higher than EPA Ecoregion recommended criteria of 0.661 mg/L. Total nitrogen concentrations are less variable between sites and years at Clinton Lake than most lakes due to stable inflow levels and other watershed factors (i.e. stable soils and farming practices). The spike in TN in June at CL-6 and Cl-12 was attributed to a high percentage (82%) of nitrates in the samples resulting from large inflows from rain events prior to sampling. The inorganic plant nutrients like nitrate is frequently linked to excessive plant/algae growth.



Total Phosphorus

Total phosphorus (TP) median concentrations from 2014 Clinton Lake samples meet WRAPS 10-year average goals for Clinton Lake at site #2 (near the dam). Median TP at all Clinton Lake sites are in the range of high biological productivity leading to high algae populations and rapid fish growth as indicated by eutrophic class designation. In 2014, Clinton TP concentrations were similar to long-term trends at the dam and outflow. However, upper lake site TP median values exceeded the 75% quartile of data collected from 10 years at the respective site. Internal loading is apparent at Cl-2 as TP values increased steadily from April-September without large inflows. Similar to most impoundments, higher TP concentrations and a wider range of data is usually found in the upper lake sites due to inflows and internal loading from nutrient rich bottom sediments while TP decreases from biological uptake as the water moves through the lake to the dam.



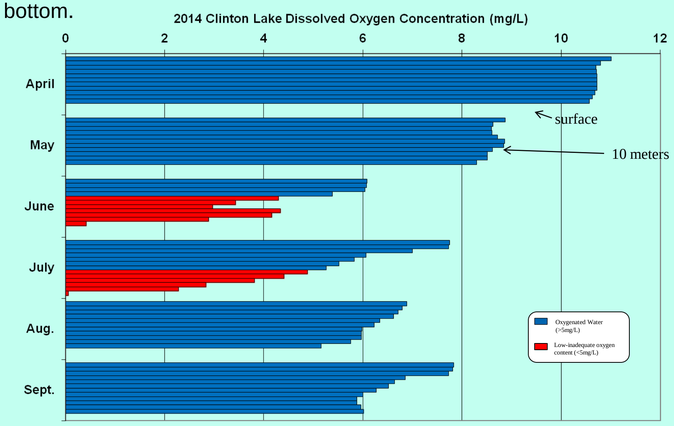


The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Clinton Lake* from April through September. These figures present data collected between 2005 -2014 from lake sites (#2,12, 18, 6), and the outflow (#1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Some lakes undergo a process called stratification or develop layers based on temperature and oxygen. This process begins in late spring, remains throughout the summer, and breaks apart (de-stratifies or 'turns over') in the fall. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April-September at the dam (CL-2). Clinton Lake typically stratifies during summer months and lack of adequate (<5 mg/L) dissolved oxygen can be a concern. In 2014, Clinton Lake showed weak stratification June-July and the top 4 meters had sufficient oxygen for fish and aquatic life. The upper lake sites mix throughout the summer so dissolved oxygen is similar from top to bottom.



Water Quality Concerns:

- Sediment inputs
- Eutrophication
- Dissolved oxygen and shallow depth of stratification

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